



U.S. Geological Survey Programs in Vermont



U.S. Department of the Interior ■ U.S. Geological Survey

For more than 100 years, the U.S. Geological Survey (USGS) has been assessing, mapping, and reporting on Vermont's earth resources. Ongoing USGS programs include topographic and geologic mapping, surface- and ground-water-data collection, water-quality assessment, research on the effects of global change, assessment of hydrologic and geologic hazards, biological resources, and mineral exploration. The USGS, through cooperative programs with many Federal, State and local agencies, contributes to the health, safety, and economic well being of Vermont's citizens.

Topographic Mapping

Maps and digital cartographic data are used for various commercial and recreational purposes. Among the most popular and versatile products of the USGS are its 1:24,000-scale topographic maps (1 inch on the map equals 2,000 feet on the ground). These maps depict natural and cultural features of the landscape, such as lakes and streams, highways and railroads, boundaries, and geographic names. Contour lines are used to depict the elevation and shape of terrain. Vermont is covered by 213 maps at this scale.

The USGS, through its National Mapping Program, fosters partnerships with Federal and State agencies to improve the effectiveness of its data-collection activities, maximize resource sharing, and enhance the availability of timely and accurate data. During 1995, the USGS and the Vermont Department of Taxes (VDT) were involved in a cooperative agreement wherein the USGS provided assistance to support the VDT's preparation of digital orthophotoquads (DOQ's) and digital elevation models (DEM's) that met USGS standards. A DOQ is derived from digitized aerial photographs and combines the image characteristics of a photograph with

the geometric qualities of a map. DOQ's and DEM's have been completed for Rutland County. DOQ's are becoming increasingly useful as a component in geographic information systems (GIS) where computer-readable layers of map data can be combined with other kinds of geographic data.

Stream Stability and Scour at Bridge Sites

The evaluation of stream stability and scour at bridge sites in Vermont contributes to the improved safety of Vermont's transportation system and enhances the knowledge of stream-scour processes at bridge settings typical of those found in the Northeast.

Nationally, the scour of streambeds and riverbanks by floodwaters is the leading cause of failures of bridges over water. Flooding in Vermont can be widespread,

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as evidenced by the historic floods of 1927, 1936, and 1938, or localized, as shown by the floods of 1973, 1976, 1984, 1989, 1990, 1992, and 1995. Millions of dollars have been spent as a direct result of flood damage, and about \$60 million has been spent on flood-control projects since the 1927 flood. An assessment of potential scour of the stream channel and banks at bridge sites is used by State agencies to design, construct, and maintain bridges properly and to avoid future failures. Vermont is evaluating the safety of all bridges over water in the State (fig. 1).



Figure 1. A covered bridge in Randolph. This is one of the 403 bridges that is being evaluated by the USGS for potential failure as a result of stream erosion (scour) during floods.

The USGS, in cooperation with the Vermont Agency of Transportation, is completing a quantitative evaluation of scour potential and stream-channel stability at 403 scour-susceptible bridge sites (fig. 2). By the end of the 1995 field season, 236 bridge sites had been evaluated. The evaluation includes a detailed survey and an assessment of the hydrologic and geomorphologic setting, floodflow frequencies, streamflow velocities, stability of streambed materials, and potential depth of scour.

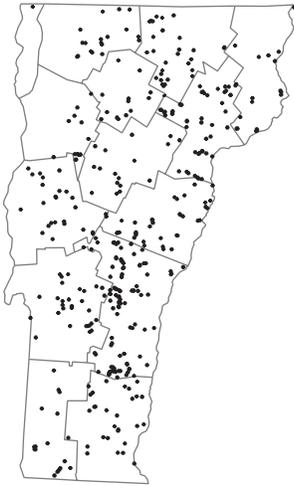


Figure 2. Locations of 403 bridge sites in Vermont that are being evaluated for stream stability and scour potential.

Geologic Mapping

The USGS, in cooperation with the Vermont Geological Survey, is collecting and compiling geologic data for a new bedrock map of Vermont at a scale of 1:100,000. The detailed bedrock data, which includes locations of outcrops, rock types, and fracture data, are being compiled and published jointly in map and digital GIS form. These reports are available from the State Geologist. The digital data base is useful to engineers, planners, National Forest managers, and Regional Planning Commissions. A sample from one of these maps is shown in figure 3. These maps, in conjunction with water-well information, can be used for assessing the potential for well-head contamination, developing water supplies, and providing baseline information for ecosystem management. This project has combined the resources of the State with those of the USGS to gather useful basic

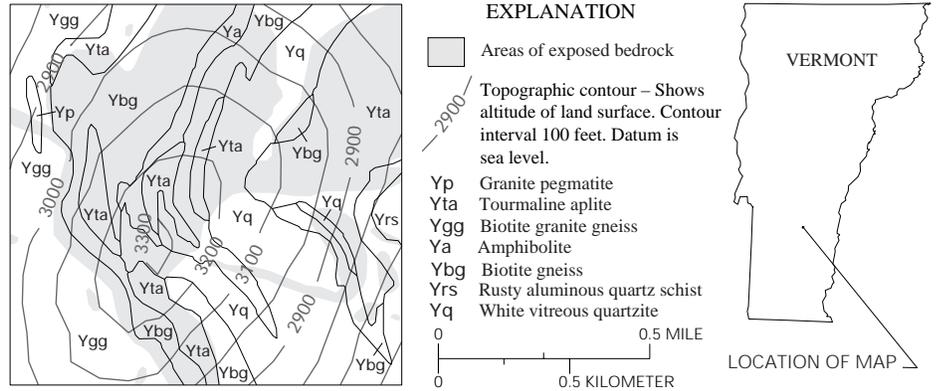


Figure 3. Sample of a part of the Digital Bedrock Geologic Map of the Mount Holly area showing bedrock outcrops and geologic units on Mount Okemo, which is a ski area. The rocks that cap Mount Holly are among the oldest in the State.

geologic data in a timely fashion and in a format that is becoming increasingly used by government and industry.

The STATEMAP component of the National Cooperative Geologic Mapping Program provides funds to address a wide variety of economic and environmental issues by supporting geologic mapping projects in Vermont. These issues range from slope-stability, road engineering, and radon hazards to ground-water quality.

Mineral Exploration and Information

The USGS has evaluated areas in Vermont for the presence of deposits of tin and tungsten. Recent geochemical investigations identified minor deposits that may be a source of economic development.

Preliminary studies by the USGS have begun to establish geochemical data bases that document baseline element abundance for rock types that contain copper and molybdenum deposits.

Mineral resources, such as slate, iron, granite, marble, and sand and gravel, from about 700 sites in Vermont are included in the USGS Mineral Resource Data System (MRDS). The MRDS is a digital data base of more than 110,000 mineral sites in the United States and worldwide. MRDS provides up-to-date information on mineral occurrences and related data to support USGS research and mineral-resource assessments. MRDS also provides mineral-related information to State agen-

cies, industry, and the public. The records in the data base for Vermont are compiled from the findings of a cooperative study with the Vermont Geological Survey, USGS studies, and other published data. Paper copies and a GIS copy of the data compiled for Vermont are available through the Vermont Geological Survey.

Landslide Hazards

The mountainous areas of Vermont, which comprise fractured bedrock with a thin soil cover, have a variety of different types of slope failures, which include rock falls, debris-flow avalanches, and fast-moving destructive landslides that result from precipitation and freeze-thaw cycles and that cause highway blockage and property damage. At the Smugglers Notch area in northern Vermont, the USGS, in cooperation with the Vermont Geological Survey, employed a multidisciplinary approach to study the types and distribution of slope-failure hazards. Slopes were monitored to evaluate the influence of external factors on slope stability. An instrumentation system was developed that has the potential for use as an early warning system for impending slope failures.

National Water-Quality Assessment Program

In 1991, the USGS began a National Water-Quality Assessment (NAWQA) Program to describe the quality of the Nation's water resources, and to identify

the natural and human-activity factors that affect it. The program provides information that is useful to water-resource policymakers and managers at Federal, State, and local levels. Data for evaluation of surface- and ground-water quality, riverbed sediments, and aquatic organisms are collected in regional study areas.

A committee of representatives from Federal, State, and local agencies; universities; and the private sector works closely with the USGS in each regional NAWQA Program study to exchange information on water-quality issues and to assist in designing and planning project products to meet the needs of the States and towns in each study area.

Vermont was included in a regional project that encompassed the Connecticut, the Housatonic, and the Thames Rivers. This study area covered 15,750 square miles in western New Hampshire, eastern Vermont, west-central Massachusetts, most of Connecticut, and small parts of New York and Rhode Island. In Vermont, this area included the western part of the Connecticut River drainage basin. A sample of findings includes the following:

- Eight volatile organic compounds (VOC's) were detected in water samples from 6 of the 11 urban wells sampled in Vermont and New Hampshire. The gasoline additive methyl tert-butyl ether (MTBE) was detected in 9 percent of the urban wells sampled. Water samples from eight bedrock wells did not contain MTBE.
- Nutrient concentrations varied among sampling locations, but none appeared either excessive or indicative of eutrophic conditions. Nutrient concentrations determined for urban and agricultural sites were higher than concentrations determined for undeveloped areas.
- The highest concentrations of pesticides were observed in storm runoff that followed spring applications; concentrations were, however, generally low (barely exceeding detection limits). Pesticides were not detected in runoff from undeveloped areas.
- Riverbed sediments show low concentrations of antimony, cadmium, copper, lead, mercury, silver, zinc, and sulfur. Polychlorinated biphenyls (PCB's) and organic pesticides [dichlorodiphe-

nyltrichloroethane (DDT), dieldrin, and chlordane] were not detected.

- Low concentrations of a DDT metabolite were detected in fish tissue at Moore Reservoir and at the Bellows Falls impoundment site. Concentrations of PCB's in fish tissue were less than the detection limits at the Moore Reservoir site, but slightly exceeded detection limits at the Bellows Falls impoundment site. At a third site—Sleepers River near St. Johnsbury—DDT metabolites and PCB's did not exceed detection limits.

Water-Data Collection

The amount of water in Vermont's rivers, streams, lakes, and reservoirs is measured and monitored by the USGS hydrologic data-collection program. The data are used for forecasting floods and droughts; water-resources planning; design and operation of projects for water supply, hydroelectric power, and flood and pollution control; designing bridges and culverts; flood warning; flood-plain management; and hydrologic research. Long-term records are needed to evaluate the responses of hydrologic systems to natural climatic variations and human-induced stresses so that potential problems can be defined early and appropriate planning and management actions can be taken by State and local agencies. Streamflow monitoring also provides baseline data on natural seasonal discharge variations of rivers and streams throughout Vermont.

In Vermont, the USGS collects surface-water data from a network of 35 continuous-record streamflow stations, 3 continuous-record lake-level stations, and 3 partial-record streamflow stations. The network is operated cooperatively by the USGS and the Vermont Department of Environmental Conservation. Records are published annually. These data are used routinely by private consultants, residents, newspapers, colleges and universities, and local government agencies throughout the State.

Realtime streamflow data are available at 14 locations throughout Vermont by way of satellite and telephone telemetry. This information is critical for flood forecasting and response duties of the

National Weather Service and the Vermont Emergency Management Agency. Telemetric data also allow State personnel to monitor drought conditions and compliance of flow-regulation projects.

Earth Science Information Center

The Earth Science Information Centers (ESIC's) provide information about USGS programs, products, and technological developments to the public. The ESIC in Burlington was established under a cooperative agreement between the USGS and the Bailey Howe Library at the University of Vermont in Burlington. As part of the national ESIC network, this office provides information on such earth science topics as cartography, geography, digital data, remote sensing, geology, geophysics, geochemistry, hydrology, geohydrology, aerial photography, and land use. It is supported by the USGS with reference materials, technical assistance, training and outreach activities, and access to USGS data bases.

Water Use

Water resources in Vermont are increasingly stressed by new demands. To minimize the impact of changing patterns in water use, available supplies and current and predicted future demands need to be carefully evaluated. Without adequate information, decisionmakers are not equipped to resolve critical issues related to water supply, hydropower, snow making, water quality, and the potential effects of streamflow withdrawals on ecosystems.

The USGS, in cooperation with the Vermont Department of Environmental Conservation, Water Supply Division, is working to improve the State's water-use information for the management of Vermont's water resources. Assistance is provided to the State in the collection, analysis, and dissemination of water-use data. Work is underway to develop a statewide water-use data base for Vermont that includes site-specific data and data aggregated by county and major drainage basins. Data extracted from this data base are organized into reports and distributed

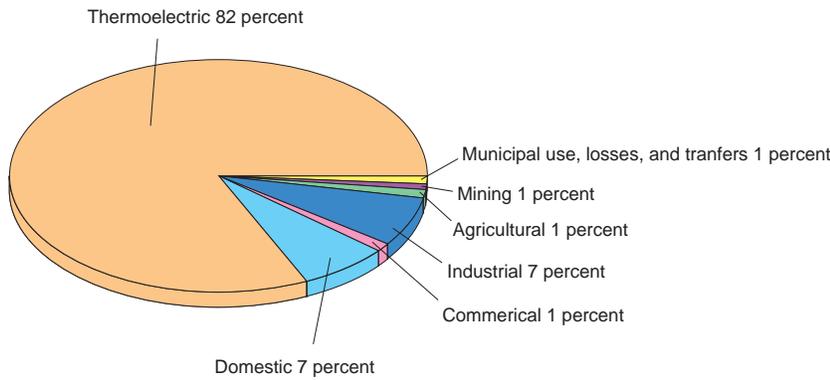


Figure 4. Total freshwater use in Vermont, by category, in 1990.

to Federal and State agencies, educators, consultants, and other organizations or individuals concerned with water resources. A report on wastewater in New England and a map report on freshwater withdrawals and use in Vermont have been produced as part of this program. An example of total freshwater use in Vermont is shown in figure 4.

Global Change Hydrology

The Sleepers River near Danville is one of the five national sites chosen for investigations of water, energy, and biogeochemical budgets, as part of the USGS Global Change Hydrology Program. This national research program monitors the effects of global environmental changes,

such as global warming, on a representative cross section of ecosystems found in the United States.

At the Sleepers River Research Watershed (fig. 5), the USGS is investigating these processes in a typical landscape of mixed forest and agricultural land use found in the Northeastern United States. Current measurements of solar radiation, air and water temperatures, rain and snow amounts, snowpack accumulation, ground-water levels, streamflow, and water quality are compared with historical records at the site (established in 1958) to detect changes and to understand their causes. Naturally occurring isotopes of oxygen, carbon, strontium, and lead are being used to trace the flow of water and dissolved materials in the basins.

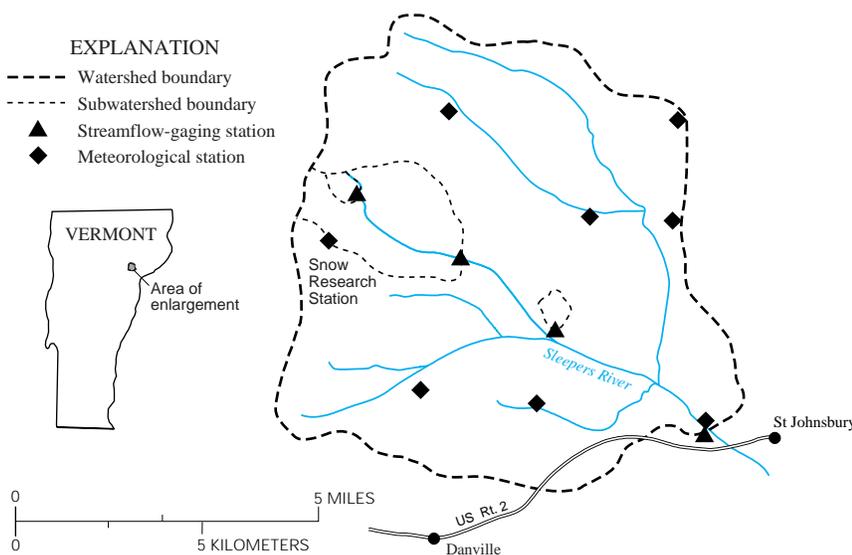


Figure 5. Location of sampling sites for the Global Change Hydrology Research Program.

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Additional earth science information can be found by accessing the USGS Home Page on the World Wide Web at <http://www.usgs.gov/>

For more information on all USGS reports and products (including maps, images, and computerized data), call **1-800-USA-MAPS**

The **USGS** provides maps, reports, and information to help others meet their needs to manage, develop, and protect America's water, energy, mineral, biological, and land resources. We help find the natural resources needed to build tomorrow and supply the scientific understanding needed to help minimize or mitigate the effects of natural hazards and environmental damage caused by natural and human activities. The results of our efforts touch the daily life of almost every American.